

## Abstract

Some embodiments of the invention are directed toward systems and methods of detecting clandestine nuclear material in the form of emitted radiation and particles (e.g.,  
5 neutrons and alpha particles). These embodiments, which may be used in conjunction with a conventional x-ray imaging system, may include an external source of penetrating radiation, at least one detector configured to detect at least penetrating radiation and to generate a detector signal, and a processor configured as a detector signal discriminator to generate an output indicating whether the detector signal is triggered by an origin other  
10 than backscattered penetrating radiation. Active and passive modes of detection are described by some embodiments. Other embodiments are directed toward neutron detection, gamma ray detection with energy resolution, and designs of detectors to enhance the detection of clandestine nuclear material.